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NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY
RESEARCH AND DEVELOPMENT DIVISION
CAMPUS STATION SOCORRO, NEW MEXICO

Status Report for Quarter Ending
31 March 1953

AIRBORNE PARTICLE STUDY

Contract N70NR-405, Task 1
Project Designation No. NR-082-013

Report No. 23

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NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY
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SOCORRO

AIRBORNE PARTICLE STUDY

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Status Report for Quarter Ending
31 March 1953

by

W. D. Crozier

Submitted by

E. J. Workman

E. J. Workman, Director
31 March 1953

AIRBORNE PARTICLE STUDY

A B S T R A C T

During the quarter ending 31 March 1953 the following activities have been carried on in the Airborne Particle Study:

1. Continued organization of the results of field tests of the tagging and tracing techniques.
2. Continued study of ice-forming nuclei, including instrumentation for photoelectric study of the surfaces of the residual ice nuclei.
3. Collection of some magnetic meteoritic particles, with a preliminary attempt to detect induced radioactivity in them.
4. Preparation of papers based upon study of natural radioactivity at different levels in the atmosphere.

INTRODUCTION

The program of Airborne Particle Study comprises broadly the collection and identification of particulate matter in the atmosphere and, as far as may be possible, interpretation of the results obtained.

Collecting equipment developed and built in the laboratory includes impaction apparatus for ground and airplane use, electrical and thermal precipitators. Several pieces of equipment have been built for continuous collection, permitting determination of particle abundance as a function of time. One electrical precipitator has been arranged to sort very small airborne particles according to their mobilities (or sizes).

Various studies have contributed to identification, classification and knowledge of the properties of airborne particles. These have included optical and electron microscopy, fluorescence, extremely small-scale chemical tests under the microscope, radioactivity studies, and studies of ice-forming properties.

A considerable amount of work has been done in tracing particles artificially introduced into the atmosphere, a procedure which makes possible the tracing of parcels of air through meteorological processes.

The following persons are participating in the work of the project: W. D. Crozier, supervisor and physicist; Mary Gourley, R. J. McCarty, and M. H. Wilkening, physicists; Ben K. Seely, chemist; and Theron Young, student.

TAGGING AND TRACING AIR PARCELS

During the organization of the results of the 1951 and 1952 field tests of the tagging and tracing technique it was discovered that at least five of the aerosol plume cross sections justify a somewhat more elaborate statistical study than seemed profitable at first. Summations of the concentrations in vertical strips across the sections appear to furnish sufficiently reliable samples to permit determination of the "time mean" aspect of the horizontal diffusion. The cross sections are at distances of 4.5 to 9 miles from the source of the plume. The statistical investigations involved are fairly laborious but it is believed they will lead to an interesting paper for publication. It may even be possible to determine which of several turbulent diffusion theories applies best to the diffusion phenomenon on the scale of the tests.

Negotiations are in progress leading to cooperation in some tagging and tracing studies contemplated by the Commonwealth Scientific and Industrial Research Organization, Division of Radiophysics, of Australia. This division, under Dr. E. G. Bowen, plans to use the techniques developed in the Airborne Particle Study in some meteorological investigations. The plan is for Mr. Ben K. Seely to spend some time in Australia assisting in setting up the program.

STUDIES OF ICE-FORMING NUCLEI

Aside from work on the preparation of two papers, most of the work on ice-forming nuclei has been in instrumentation for a photoelectric study of the residual nuclei described in several preceding status reports.

This investigation, suggested by Dr. Walter Drost-Hansen of another project, presumes that the very long times (hours) required for evaporation of submicroscopic ice particles, as contrasted to the rapid nucleation and growth (in a fraction of a second) of ice upon these particles, is associated with an energy barrier at the surface which is dependent upon the particle size. Study of this energy barrier may be possible by photoelectric means.

A suitable ionization chamber has been built, into which the nuclei can be introduced and illuminated with various wave lengths of ultraviolet light. In addition to determination of photoelectric thresholds, it is hoped that mobilities and sizes of the nuclei can be measured.

STUDY OF METEORITIC PARTICLES

Some collections of magnetic meteoritic spherules have been made, using an exposed collecting surface backed by a strong magnet. The apparatus collects approximately one such spherule per day, so the experiment obviously is not a fast-moving one. This rate indicates that

the spherules are probably in a concentration of the order of one in several hundred m³ of air, which more or less is new information, since in most of the previous work the collections have been made from rain or snow. The spherules seem to have the characteristics previously reported by Buddhue, Mininger, and others.

One of the purposes in collecting the meteoritic spherules was the study of possible radioactivity induced in meteoritic material by cosmic rays. So far, one attempt has been made to find such radioactivity by imbedding approximately eight of the spherules in a nuclear photographic emulsion and storing this for two weeks before development. The results were negative and, while not conclusive, suggest that the induced radioactivity, if present, may be at a level not easily detected by this means.

RADIOACTIVITY STUDIES

Most of the work in this portion of the project has been in the preparation of two papers, based upon the airplane studies of the summer of 1952. These papers will be presented at the Tempe, Arizona, meeting of the A.A.A.S., during the latter part of April. The first paper, "Altitude Dependence of the Natural Radioactivity in the Atmosphere," will be presented by Dr. Wilkening; the second, "Analytical Treatment of Natural Radioactivity in the Atmosphere as a Function of Altitude," will be presented by Mr. Young.

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